CANDIDATE'S NUMBER

(For the use of the Department only)

Tests
D-2

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DEPARTMENT
EDUCATION ALBERTA

HIGH SCHOOL AND UNIVERSITY MATRICULATION

EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1965
SUPPLEMENTAL

CHEMISTRY 30

Time—3 hours

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE DIRECTIONS FOR EACH QUESTION CAREFULLY.

Total Possible Mark—200

All your work must be done in this booklet.
Do not write your name on this booklet.

Mathematical tables may be used.
Slide rules are permitted.

Page 2A contains the Periodic Table. This page, for convenience, should be torn out for ready reference when required.

Rough work and diagrams may be done in pencil.
Finished work must be done in ink (blue or black).

In solutions to problems enough work must be shown to indicate the method used. Give numerical answers to the NEAREST TENTH unless otherwise indicated.
Include units.

DO NOT FOLD THE BOOKLET.

Place your test booklet in the answer envelope in such a way that the **UPPER LEFT HAND CORNER OF THE BOOKLET** (Candidate's Number) shows through the **SLASHED CORNER** of the answer envelope.

BE SURE TO SEAL THE ENVELOPE.

Atomic Weights

H	1.0	Cl	35.5	N	14.0
C	12.0	Cu	63.5	Na	23.0
Ba	137.4	Fe	55.9	O	16.0
				S	32.1

Gas constant, R = 0.0821 liter atmospheres per degree per mole.

(For the use of Sub-Examiners only)

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CURR HIST

Place the NUMBER corresponding to the best answer in the brackets to the right. Each correct answer has a value of 2 marks for questions 1 to 20 inclusive.

1. The Bohr model of the atom was successful in explaining
(1) existence of isotopes
(2) existence of the rare gases
(3) polarity of the water molecule
(4) the hydrogen spectrum (..................)

2. Saponification results in the formation of a soap and
(1) glycerol
(2) an ester
(3) a fat
(4) an alkali (..................)

3. The spectral lines of an element correspond to
(1) the electron shells in the atom
(2) permitted energy changes of the electron in the atom
(3) the orbitals in the atom
(4) its valence (..................)

4. The atomic number of an isotope of hydrogen is
(1) always 1
(2) sometimes 2
(3) sometimes 3
(4) zero (..................)

5. Fluorine is the most active halogen because it has the
(1) fastest molecules
(2) highest electronegativity
(3) lowest density
(4) lowest boiling point (..................)

FOR ROUGH WORK

(No marks given for work in this space)

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QUAECUMQUE VERA

6. One Angstrom equals
(1) 10^{-10} millimeters
(2) 10^{-10} centimeters
(3) 10^{-10} meters
(4) none of these (..................)

7. The action of concentrated sulphuric acid on carbohydrates is known as
(1) esterification
(2) hydrolysis
(3) dehydration
(4) hydrogenation (..................)

8. In the Periodic Table, the metallic characteristics of the elements generally increase from
(1) right to left and bottom to top
(2) left to right and bottom to top
(3) left to right and top to bottom
(4) right to left and top to bottom (..................)

9. The type of bond formed when two atoms share a pair of electrons is called
(1) ionic
(2) covalent
(3) bivalent
(4) electrovalent (..................)

10. The energy required to remove an electron from an atom is called the
(1) ionization potential
(2) kinetic energy
(3) mass number
(4) oxidation potential (..................)

11. A molecule is said to be polar if it
(1) has a north and south pole
(2) has a symmetrical charge distribution
(3) exhibits a partial positive charge at one end and a partial negative charge at the other
(4) exhibits a positive or negative charge (..................)

FOR ROUGH WORK

(No marks given for work in this space)

12. A diamond is a good example of
(1) a molecular solid
(2) an ionic solid
(3) a metallic solid
(4) a covalent solid
(..........)

13. Which of these gases measured under the same conditions of pressure and temperature has the greatest density?
(1) SO_2
(2) NH_3
(3) CH_4
(4) CO_2
(..........)

14. The number of L electrons present in the last element of the fourth series of the Periodic Table is
(1) 8
(2) 2
(3) 18
(4) 32
(..........)

15. The hydronium ion is a hydrated
(1) electron
(2) radical
(3) proton
(4) neutron
(..........)

16. In the compound $K_4Fe(CN)_6$ the oxidation state of Fe is
(1) -3
(2) $+2$
(3) $+3$
(4) -2
(..........)

FOR ROUGH WORK
(No marks given for work in this space)

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17. Which electron configuration represents the most active non-metallic element?
(1) 2, 8, 1
(2) 2, 8, 3
(3) 2, 8, 7
(4) 2, 8, 8 (..................)

18. According to Dulong and Petit for many metals a constant of about 6.3 is obtained by
(1) multiplying atomic weight by specific heat
(2) dividing atomic weight by specific heat
(3) multiplying atomic number by specific heat
(4) dividing specific heat by atomic number (..................)

19. Which compound is classed as a basic anhydride?
(1) NaOH
(2) BaO
(3) CO_2
(4) SO_3 (..................)

20. An unpaired electron in an atom or molecule gives it the property of
(1) polarity
(2) diamagnetism
(3) electronegativity
(4) paramagnetism (..................)

FOR ROUGH WORK

(No marks given for work in this space)

Values

15 **21.** Complete each of the following statements by writing an appropriate word or phrase in the space provided.

(a) A measure of the tendency of an element to attract electrons to itself in a chemical reaction is called its ....

(b) Amino acids show a high polarity because of a proton shift from one end of the molecule to the other, thus forming an ion called ....

(c) The regular arrangement of atoms, ions of molecules in a solid is called a ....

(d) An instrument which measures the charge-to-mass ratio of positive particles is called the ....

(e) A plastic fluorocarbon produced by polymerization and inert to chemical attack is known as ....

(f) Positive beta rays are sometimes called positive electrons or ....

(g) The probability pattern for locating the electron in an atom is called ....

(h) Compounds having the same molecular formula but different structural formulas are called ....

(i) The name of the compound whose formula is $C_{10}H_{22}$ is ....

(j) The Periodic Law was discovered independently in the 19th century by the Russian Mendeleev and the German ....

(k) Two or more forms of the same element which possess different properties are called ....

(l) The filling of "d" orbitals gives rise to series of elements called ....

(m) The Uncertainty Principle was formulated by ....

(n) A series of dark lines found in the solar spectrum are designated as ....

(o) A Brønsted-Lowry acid is a ....

Values

4 **22.** A neutral atom of a certain element "X" has two electrons in the K-shell, 8 in the L-shell, 8 in the M-shell and 2 in the N-shell.

(a) This atom has .... "s" electrons.

(b) It has a total of .... "p" electrons.

(c) The formula of its simplest compound with oxygen will be ....

(d) The type of bonding in its simplest compound with chlorine will be ....

....

3 **23.** (a) Indicate by a drawing the three-dimensional representation of the shape of the ammonia molecule NH_3.

3 (b) Explain this shape in terms of the atomic orbitals of nitrogen.

....

....

....

....

....

....

....

FOR ROUGH WORK

(No marks given for work in this space)

Values

3 **24.** (a) Sketch and label the apparatus used to determine the electrical conductivity of solutions.

4 (b) One molar solutions of the following compounds were tested in the conductivity apparatus:

HCl, $NaCl$, H_2SO_4, NH_4OH, $HC_2H_3O_2$ (CH_3COOH), C_2H_5OH, $NaOH$

(1) Which of the above are strong acids?

....

(2) Which of the above are weak electrolytes?

....

Values

4 **25.** Give an explanation of the fact that solutions of $Cr_2(SO_4)_3$ are acidic.

4 **26.** Make a drawing of the cross-section through a p orbital of an atom, using shading to indicate probability density of the electron.

FOR ROUGH WORK

(No marks given for work in this space)

Values

6 **27.** Briefly account for the existence of three isomers of dichlorobenzene. Use sketches of the molecule to illustrate your answer.

5 **28.** In your text the statement is made that "there is no sharp distinction between ionic and covalent bonds". Discuss.

Do Not
Write In
This Space

Values

3 **29.** (a) Indicate how edible oils differ from fats in their chemical structure.

2 (b) Explain the process whereby oils are converted to fats.

6 **30.** Explain how the structures of diamond and graphite account for their different physical properties; e.g. diamond is hard and brittle while graphite is soft.

Do Not
Write In
This Space

Values

10 **31.** Write a structural formula for the FUNCTIONAL GROUP characteristic of each of the following CLASSES of compounds:

(a) aldehyde

(b) ether

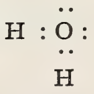
(c) carboxylic acid

(d) ester

(e) ketone

8 **32.** Give the electron-dot formula (electronic formula) of each of the following ions or molecules:

Example: water H_2O



$$\begin{array}{ccc} & \cdot\cdot & \\ \mathrm{H}\ : & \mathrm{O} & : \\ & \cdot\cdot & \\ & \mathrm{H} & \end{array}$$

(a) ammonium ion NH_4^+

(b) hydrogen peroxide H_2O_2

(c) acetylene C_2H_2

(d) fluorine F_2

Values

10 **33.** Write balanced equations for each of the following:

(a) Chlorine is bubbled through a sodium iodide solution.

....

(b) Hydrochloric acid is added to a small amount of sodium bicarbonate.

....

(c) Hydrogen sulfide is bubbled through a solution of lead acetate.

....

(d) Carbon dioxide is bubbled through limewater.

....

(e) The fermentation of glucose ($C_6H_{12}O_6$).

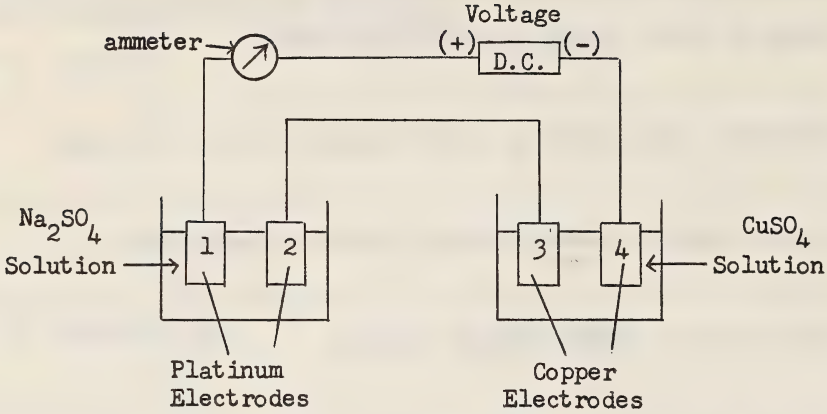
....

FOR ROUGH WORK

(No marks given for work in this space)

Values

34.



The diagram above shows how an electrolysis experiment was set up. A current of 0.1 amperes flowed for 10 minutes. The following questions apply to this experiment.

In the brackets to the right indicate the number of the best answer.

3 (a) If the copper electrodes in the right hand cell were dried and weighed together before and after the experiment their total weight would be expected to

(1) remain the same
(2) increase by .02 grams
(3) increase by .04 grams
(4) decrease by .02 grams
(5) decrease by .04 grams (..................)

3 (b) If the sodium sulphate solution contains an indicator this should show that at the end of the experiment

(1) the solution near the anode (positive) is acidic and that near the cathode is basic
(2) the solution is basic at both electrodes
(3) the solution is acidic at both electrodes
(4) the solution is neutral at the cathode and acidic at the anode
(5) the solution is basic at the anode and acidic at the cathode (..................)

3 (c) In the sodium sulphate solution you would expect

(1) H_2 gas to appear at electrode (1) and O_2 gas to appear at electrode (2)
(2) Oxygen gas to appear at electrode (1) and hydrogen gas to appear at electrode (2)
(3) Oxygen gas to appear at electrode (1) but no gas at electrode (2)
(4) Hydrogen gas to appear at electrode (1) but no gas at electrode (2)
(5) None of these
(..................)

FOR ROUGH WORK — Use the next page

Values

2 **35.** (a) How would you adjust a bunsen burner so as to produce a yellow flame?

3 (b) What is responsible for the yellow color?

2 (c) How could you demonstrate this?

FOR ROUGH WORK
(No marks given for work in this space)

Values

4 **36.** Sodium metal is a good conductor of electricity. Account for this fact in the light of its structure.

37. What is the mass of a single molecule of water

3 (a) in grams?

1 (b) in atomic mass units

4 **38.** Calculate the number of moles of O_2 required to oxidize 100 grams of Fe to Fe_2O_3.

Equation: $4Fe + 30_2 \rightarrow 2Fe_2O_3$

FOR ROUGH WORK

(No marks given for work in this space)

Values

For the next four problems numbered 39, 40, 41 and 42 check (√) the correct answer. Show your work in the space to the left of the suggested answers.

4 **39.** How many moles of NaOH are required to neutralize the acid in 12 ml. of 2.5 M HCl?

(a) 30 moles (..................)
(b) 4.8 moles (..................)
(c) 210 moles (..................)
(d) 0.030 moles (..................)
(e) 0.21 moles (..................)

4 **40.** A 25 ml. sample of 0.14 M H_2SO_4 required 22 ml. of a certain NaOH solution to neutralize it. The concentration of the NaOH solution is

(a) 0.062 M (..................)
(b) 0.079 M (..................)
(c) 0.16 M (..................)
(d) 0.25 M (..................)
(e) 0.32 M (..................)

FOR ROUGH WORK

(No marks given for work in this space)

Values

4 **41.** A 50 ml. sample of 0.31 M HCl was added to 100 ml. of water in a beaker, then 0.26 M NH_4OH was added to just neutralize it. The volume of NH_4OH required should be

(a) 20 ml (..................)

(b) 42 ml (..................)

(c) 60 ml (..................)

(d) 126 ml (..................)

(e) 180 ml (..................)

4 **42.** 6.0 grams of pure NaCl were dissolved in enough water to make 800 ml of solution. The concentration of the solution was

(a) 0.082 M (..................)

(b) 0.13 M (..................)

(c) 0.44 M (..................)

(d) 0.82 M (..................)

(e) 7.8 M (..................)

FOR ROUGH WORK

(No marks given for work in this space)

Values

6 **43.** A flask whose volume is 250 ml is filled with a vapor at 730 mm and 97 degrees C. If the vapor weighs 1.60 grams, what is its molecular weight? (Give answer to the nearest whole number.)

5 **44.** Two compounds have the following proportions:

Compound A is 50% sulfur, 50% oxygen

Compound B is 40% sulfur, 60% oxygen

Show how these facts illustrate the Law of Multiple Proportions.

FOR ROUGH WORK

(No marks given for work in this space)

Values

6 **45.** Calculate the pressure exerted by 60 grams of CO_2 stored in a 50 liter container at 350 degrees C.

4 **46.** A hydrate of barium chloride $BaCl_2 \cdot x\ H_2O$ weighing 1.222 grams was heated until all the combined water was expelled. The dry powder remaining weighed 1.042 g. Compute the formula for the hydrate.

FOR ROUGH WORK

(No marks given for work in this space)

Values

5 **47.** In the process of identifying cations and anions, particular reagents (chemical compounds) are employed. For each of the following tests, indicate the reagent used to obtain the following reactions:

(a) In the confirmation of Hg^{++} cation a grey or black precipitate results on the addition of ....

(b) In the detection of the cation Fe^{+++} a compound called Prussian Blue is obtained when, to the original solution, we add the reagent ....

....

(c) In the laboratory test for the sulphide (S^{--}) anion the reagent used is

....

(d) A white precipitate results in the identification of a sulphate (SO_4^{--}) if, to the original, we add the compound ....

(e) The test for the Al^{+++} cation requires the heating of $Al(OH)_3$ on a charcoal block in the presence of ....

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